

Eliminate Dead-End Water

A few things improve with age—red wine, some cheeses, and scotch. But most things—fresh fruits and vegetables, automobiles, your health, and treated potable water—don't. **BY ROBERT GALVIN**

UNCIRCULATED POTABLE water in distribution dead-ends can pose a serious health problem for consumers. As this water ages, disinfectant residuals decline and disinfectant by-products (DBPs) increase, creating health risks for consumers and regulatory headaches for distribution and water quality managers.

RECOGNIZE THREATS

Distribution and water quality managers can mitigate the effects of uncirculated water in their distribution systems by recognizing the causes.

Falling Residual Levels. As uncirculated water stands in water-main dead-ends, disinfectant residual levels begin to decrease within 200 hours, or about

8.3 days, as illustrated in the accompanying figure. Depending on initial disinfectant levels, water may become unsafe within 30 days or less. And, because dead-ends are usually located at the periphery of a distribution system, initial residual levels usually average less than 0.1 mg/L.

When residuals fall below the recommended minimum level, they can't control growth of microbial pathogens, including bacteria, viruses, protozoa, and other organisms, which originate from fecal matter found in sewage discharges, leaking septic tanks, and runoff from animal feedlots. The recommended disinfectant residual levels prescribed by the US Environmental Protection Agency (USEPA) for free and combined chlorine range from 0.5 mg/L to 4.0 mg/L. Therefore, if the average residual level in a noncirculating dead-end is 0.7 mg/L or less, which is common, chlorine residuals may fall to unsafe levels in about one week.

Rising DBPs. Although disinfectants have effectively eliminated and controlled microbial pathogen growth and spread for more than a century, they also carry a serious side effect. When naturally occurring organic material in water comes into contact with disinfectants over a period of time, the disinfectants can be transformed into DBPs, such as trihalomethanes (THMs) and haloacetic acids (HAAs). When consumed, these DBPs have been shown to cause health problems in humans, such as atherosclerosis and cancer. DBPs can form

in disinfected water in as little as 4–7 days.

USEPA recently released the Stage 2 Disinfectants/Disinfection Byproducts Rule (D/DBPR)—part of the larger Microbial Disinfectant Byproducts (MDBP) regulations—that addresses microbial pathogens and DBP risks. The Stage 2 level is 0.80 mg/L or less for THMs and 0.06 mg/L or less for HAAs.

IDENTIFY DEAD-ENDS

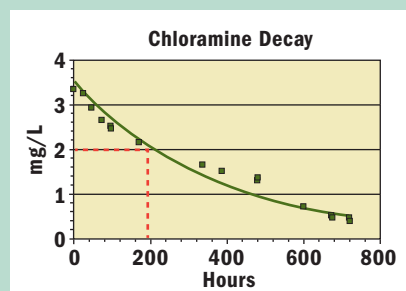
Not all dead-ends are created equal. Just because a particular waterline is a dead-end doesn't mean it's an instant hazard. Identifying hazardous dead-ends and properly allocating resources are key to addressing potential health problems. Several tools and methods can help you determine if a dead-end is potentially hazardous.

Water Quality Calculator. A water quality calculator can help distribution and water quality managers approximate water age in a dead-end waterline. With simple data inputs—pipe size, dead-end length, and the number of service connections—a calculator automatically computes the amount of water contained in the dead-end pipe and the amount of uncirculated water left in the pipe in a one-day snapshot. Although the volume may seem large, it isn't necessarily the main cause of concern.

Knowing the number of days it takes existing service connections to draw off the old uncirculated water and subsequent replacement with freshwater is key to determining whether a dead-end

Depressed Disinfectant Residual

Chlorine and chloramines decay over time and can quickly fall to unsafe levels.





Water often becomes stagnant or degrades in dead-end mains, which are often found in cul-de-sacs. Many water systems find it necessary to set up special programs to flush these dead-end mains periodically to maintain acceptable water quality. Looped mains generally flow continually in one direction or another, so they don't experience this problem.

may be hazardous. For example, if the number of days needed to turn over the uncirculated water in the pipe is greater than 7 days, it's possible to calculate a recommended flushing time per day to remove the potentially hazardous water from the system. This information can help distribution or water quality managers decide whether to address the problem with manual flushing schedules or automatic flushing systems.

Dead-End Analysis. Although a water quality calculator can provide information on water age on a single dead-end at a time, many distribution systems may contain hundreds, if not thousands, of dead-ends. Analysis of an entire distribution system can identify and categorize dead-end lines. This information can help managers focus on problem areas and base decisions on resource allocations.

Residual Measurement. To measure disinfectant residuals in dead-ends, manually sample water at a fire hydrant (or blowoff) at or near a waterline dead-end. Make a note of the residual level and compare it with USEPA minimum

requirements. Proceed backward up the line, taking additional samples at each fire hydrant until reaching a site where the residual level equals or exceeds the desired minimum level. With this information, you can determine the length of pipe that should be flushed.

If resources are limited, portable devices attached to fire hydrants automatically sample and analyze residuals, flush lines to maintain prescribed residuals, and provide data for analysis. If you already use an automatic flushing system, captured data can help you calibrate flushing times and maximize water conservation.

DATA ARE KEY

Basing decisions on quantitative data is key to effective resource allocation and decision making. Many water quality devices, such as automatic flushing systems, were recently approved by USEPA under its Green Project Reserve Funding Program, which enables public municipal and rural water districts to apply for grants and long-term low-interest loans to help implement solutions to improve water quality.

RESOURCES

AWWA (www.awwa.org):

- How Important Is a Systemwide Flushing Program? *Opflow*, Question of the Month, December 2010.
- How Old Is Too Old for Distribution System Water? *Opflow*, Question of the Month, March 2011.
- Manual of Water Supply Practices M28: *Rehabilitation of Water Mains*, 2001.
- Optimizing Distribution System Water Quality, AWWA Webcast, January 2010.
- Standard C651-05, Disinfecting Water Mains.
- Unidirectional Flushing: Enhance Water Quality and Improve Customer Relations, *Opflow*, March 2010.
- *Water Supply Operations: Flushing and Cleaning DVD*, 2006

USEPA (www.epa.gov):

- Microbials and Disinfection Byproducts.
- Research Plan for Microbial Pathogens and Disinfection By-products in Drinking Water.
- Stage 2 DBP Rule.
- Total Coliform Rule.